Space Weather Technical Forecast

Issued on Monday, 14 November 2022 at 00:48 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (Minor to Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has been Low with numerous minor C-class flares, mostly from the two larger regions in the northwest. AR3140 and AR3141 are the two largest regions on the disc, but neither are showing significant magnetic complexity at the moment. AR3140 has shown some proliferation of its intermediate spots, however. There are currently four numbered sunspot regions on the visible disc but the remaining two regions are both small and simple.

A filament liftoff was observed from near south centre disc this morning which gave a very weak and slow CME. This is expected to pass mostly below Earth's orbit, and is unlikely to give significant impacts if it does give a glancing blow. Otherwise no Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 by DSCOVR, was indicative of waning high speed stream influences. Wind speeds were slightly elevated, largely between 430-500 km/s. Density has been at average to below average levels. Total magnetic field strength (IMF) has been weak throughout below 7 nT. The north-south component, Bz, has fluctuated weakly between +6/-5 nT. Phi angle has been largely negative (towards the Sun), but with some variation after 13/1300 UTC. Geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has been at background to moderate levels, with a peak of 392 pfu at 13/1825 UTC. Electron fluence levels remained well below Active (1e8 integrated pfu) levels but with a slight rising trend. Observed fluence at 14/0001 UTC was 3.42e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be generally Low, with a chance of isolated M-Class flare activity. The most likely source of flare activity is from the two largest regions on the disc in the northwest quadrant, AR3140 and AR3141.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are likely to give significant impacts at Earth. Some minor CME effects are possible through this period, however any potential impacts would be expected to be weak. A very weak and slow CME may give very minor impacts on 18 Nov.

Solar winds are currently at slightly elevated levels due to waning coronal hole influences. Winds are expected to continue to slowly decline during Day 1 (14 Nov). There are two small coronal holes which are likely to give some enhancement on Day 2 (15 Nov). They may prolong the period of slightly elevated wind speeds into Days 3 or 4 (16-17 Nov), although confidence is low due to differences from the previous rotation. Geomagnetic activity is expected to be predominantly Quiet to Unsettled through the period, perhaps with a chance of isolated Active intervals if we get a CIR associated with the two coronal holes on Day 2, or if we see any weak

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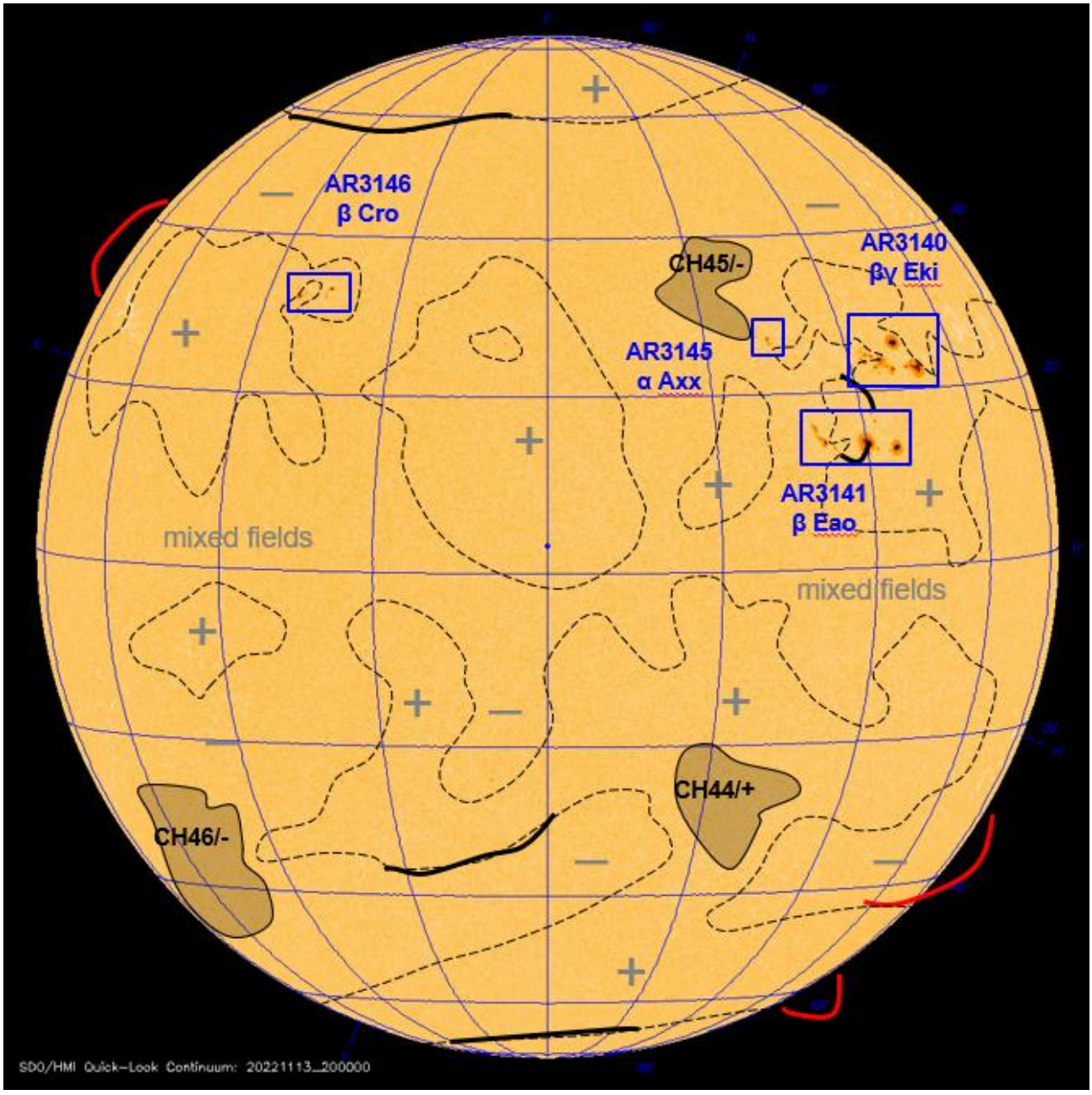
CME related enhancements.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is most likely to remain at background levels. However, there is a slight chance of an increase in solar radiation from AR3140 and AR3141 in the western hemisphere. Electron flux is forecast to be at background to moderate levels throughout the period. Fluence values are expected to remain below or well below the Active (1e8 integrated pfu) threshold throughout the period.

Figure 1. Solar Analysis Valid 13/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are likely to give significant impacts at Earth. Some faint ejecta cannot completely be discounted as having some Earth directed component, however any potential impacts would be expected to be weak. A filament liftoff was observed from near south centre disc this morning which gave a very weak and slow CME. This is expected to pass mostly below Earth's orbit on 19 Nov, and is unlikely to give significant impacts if it does give a glancing blow.

Solar winds are currently at slightly elevated levels due to ongoing, but waning coronal hole influences. Winds are expected to continue to slowly decline during Day 1 (14 Nov) as HSS effects wane. There are two coronal holes at a similar longitude on the disc: CH45/- in the north and CH44/+ in the south are both small, non-recurrent features. These are likely to give some enhancement on Day 2 (15 Nov), although it is difficult to tell which of these features may become geoeffective at Earth as they are similar latitudinal distances away. Either way, they may prolong the period of slightly elevated wind speeds into Days 3 or 4 (16-17 Nov), although confidence is low due to differences from the previous rotation.

Geomagnetic activity is expected to be predominantly Quiet to Unsettled through the period, perhaps with a chance of isolated Active intervals if we get a CIR associated with the two coronal holes on Day 2, or if we see any weak CME related enhancements.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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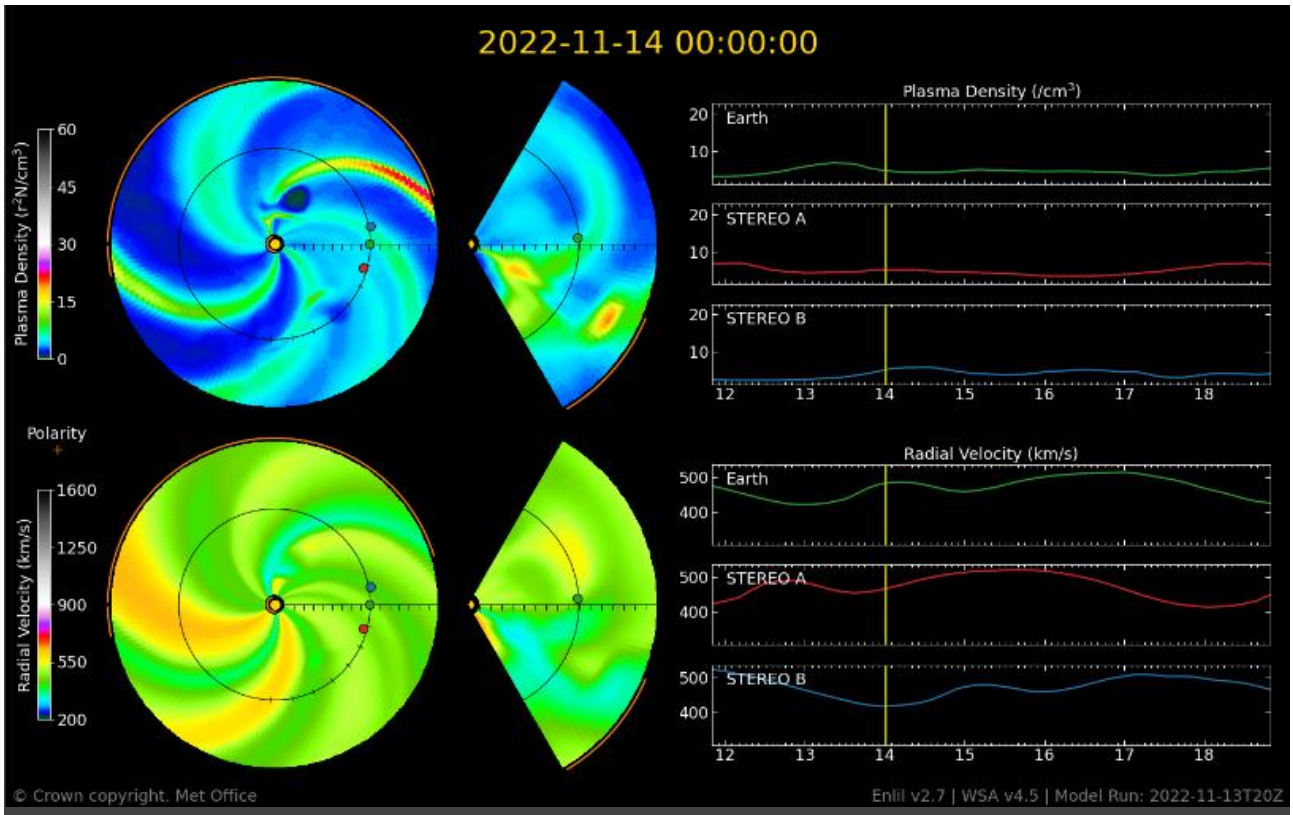
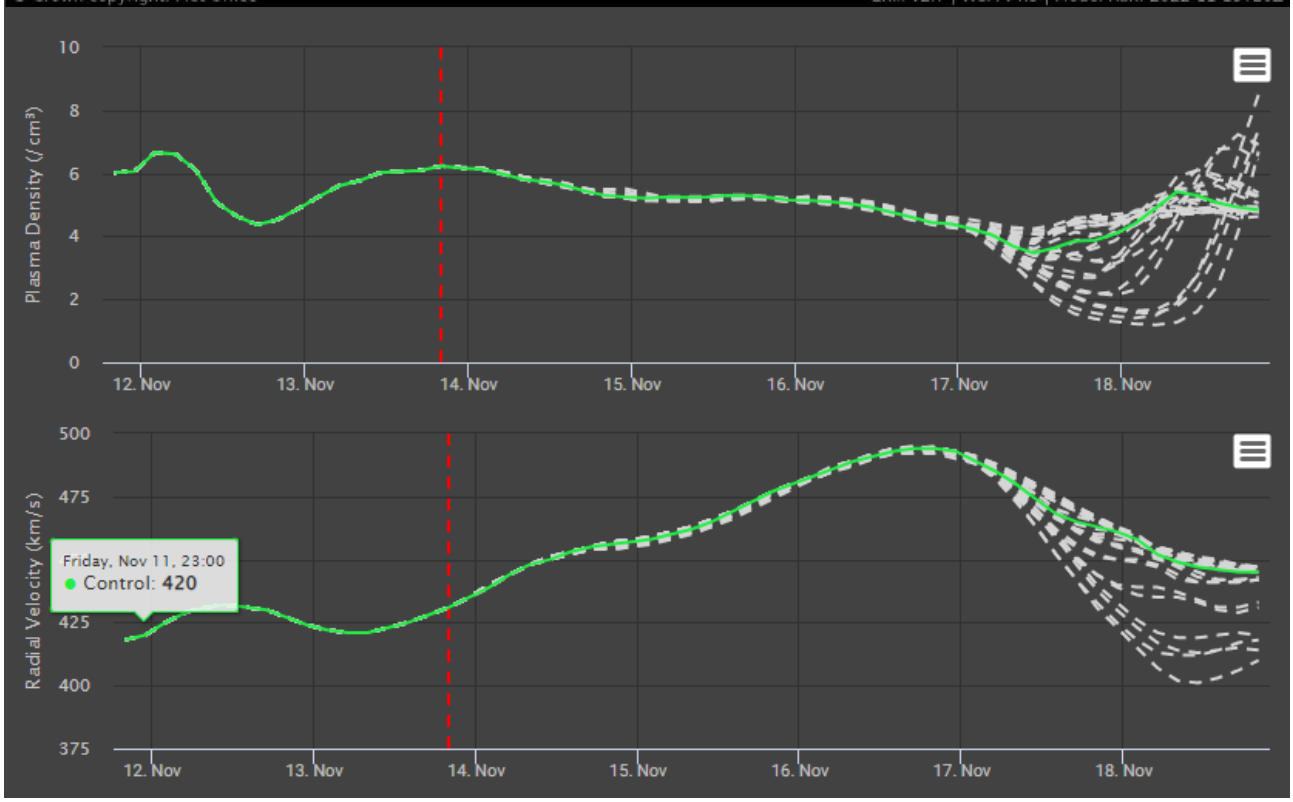
Figure 2: MOSWOC Enlil and ensemble. Enlil is currently considered to be a little too high with forecast wind speeds through the next few days. Some ensemble members are suggesting a CME arrival on 18 November.





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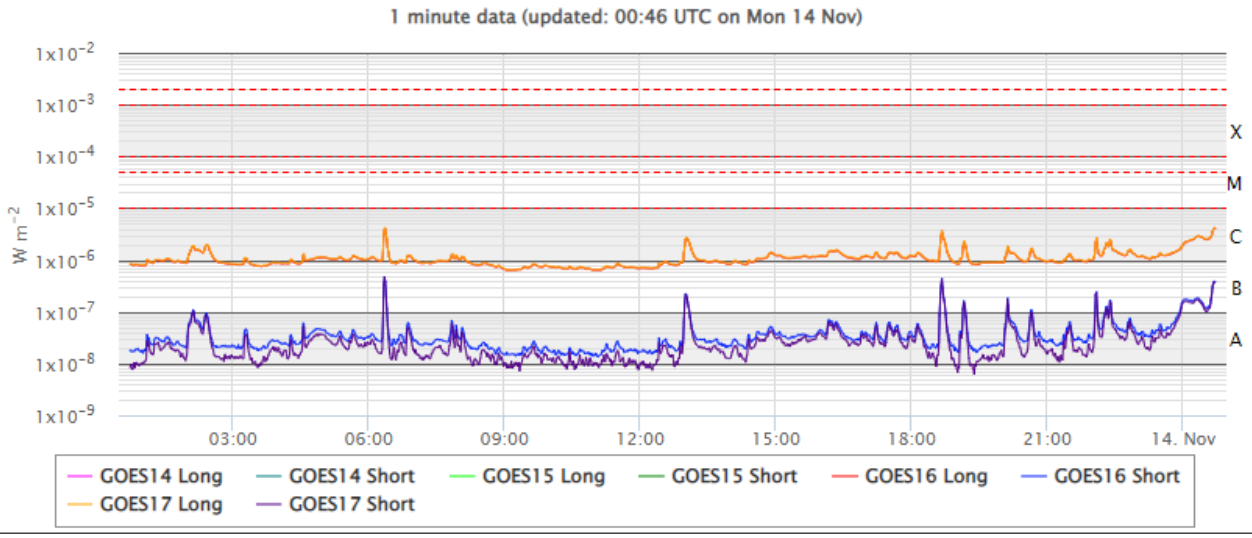
Radio Blackouts - X-Ray Flares:
Solar activity is expected to be generally Low, with a chance of isolated M-Class flares. The most likely source of activity is from the two largest regions on the disc both in the northwest: AR3140 (Eki/Beta) and AR3141 (Eao/Beta). Neither is showing significant magnetic complexity at the present time, although AR3140 has shown proliferation in its intermediate spots.

Both AR3140 and AR3141 will rotate off the disc during Day 4 (17 Nov), although they will still pose some risk of flaring until they are well over the limb. There are also a couple of potential new regions to rotate onto the disc in the coming days, although it is difficult to assess the likelihood of flaring from these until they become fully visible. As such, the risk of flares has been kept flat through the four days.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Recent flare activity has been confined to C-class.



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) at GEO, as observed by GOES-16, is currently at background levels and is most likely to remain at this level throughout the period. However, as AR3140 and AR3141 transit across the western solar hemisphere they give a slightly increased risk of proton storms over background conditions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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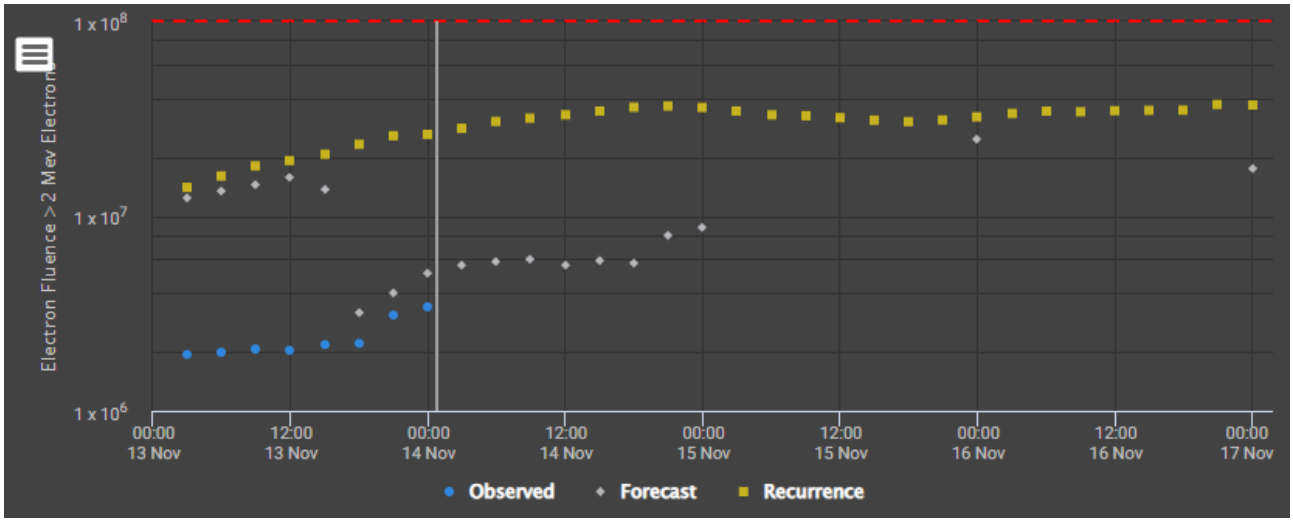
High Energy Electrons Event (≥ 2MeV):
Electron flux (greater than 2MeV) is currently at mostly background levels, and is forecast to be at background to moderate levels through the period. The recent weak high speed stream didn't produce much in the way of geomagnetic activity so significant charging in the radiation belt is considered unlikely to have occurred. Whilst a further weak high speed stream is possible on Days 2 and 3 (15-16 Nov) from two small coronal holes, again significant charging is considered unlikely from either of these features. As such, moderate electron flux is possible at the diurnal maxima but higher levels are unlikely, with reasonable confidence.

Electron fluence values are well below the Active (1e8 integrated pfu) threshold and are expected to remain so throughout the period, with a slight rising trend possible. The MOSWOC REFM currently supports electron fluence values remaining below the Active threshold on a slight rising trend. Fluence levels on the last rotation remained below the Active threshold and wind speeds were slightly higher last time around so a similar trend seems reasonable.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM showing a slight rise in fluence, but below the Active (1e8 integrated pfu) threshold.



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